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TEMPERATURE PATTERNS ALONG THE ATLANTIC AND GULF COASTS

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1. INTRODUCTION

As part of a recent survey of coastal climates of the United States, a study was made of air temperature patterns along the Atlantic coast and the Gulf of Mexico. This investigation serves as an example of the type of local climatological analysis that can be performed using existing data, without the need for setting up new and often costly observational programs. In addition, this study showed an interesting feature of the daily maximum temperature pattern—an "inland tongue" of high temperature—that does not appear on large scale maps of temperature distribution for the United States.[1]

The data in this study were the average daily mean, maximum, and minimum temperature for approximately 500 cooperative observing stations, as well as first order Weather Bureau stations, along the Atlantic and Gulf coasts. Sources of data were *Climatic Summary of the United States—Supplement for 1931 through 1952* and *Local Climatological Data*, published by the U.S. Weather Bureau. Figures 1 and 2 show the networks of stations along the Atlantic and Gulf coasts, respectively.

Although the station network used in this study is quite dense, there were three major sources of difficulty. First, the various cooperative observing stations do not have a uniform period of record. An attempt was made to overcome this problem by eliminating stations with short records (less than 5 years), and stations with inconsistencies caused by changes in station location. Second, stations are not equally distributed over different kinds of terrain—for example, there are few stations high up on mountain slopes—and there are differences in the temperature statistics due to differences of station exposure. To compensate for this, subjective smoothing was done in drawing isotherms. Also analyses of regions of sparse data were made in accordance with the temperature-altitude relationship which was evident in regions of dense data. Third, the absence of observations of air temperature over water made it difficult to analyze coastal areas and regions with inland bodies of water such as Long Island Sound, Chesapeake Bay, and Lake Ponchartrain.

Despite these data deficiencies, the networks were sufficiently dense to delineate features of the temperature patterns caused by local topographical features and bodies of water.

2. TEMPERATURE PATTERNS

The patterns of daily mean and minimum temperature appeared very much as expected. The mean temperature decreases with increasing elevation, and is higher over land in summer and higher over water in winter. These two effects, due to topography and land-water contrast, reinforce each other in winter and oppose each other in summer. The minimum temperature also decreases with elevation, and is higher over water than over land throughout the year.

The patterns of average daily maximum temperature show an unusual feature which merits examination in greater detail. The highest maximum temperature is

[1] The latest edition of "Climates of the States", published by the U.S. Weather Bureau, includes maps showing the mean daily maximum and minimum temperatures for each State during January and July, based on data from the cooperative observing stations. The Atlantic and Gulf States for which these maps have been published as of December 1959 are Alabama, Florida, Georgia, Maine, and Massachusetts. The "inland tongue" appears on these maps.

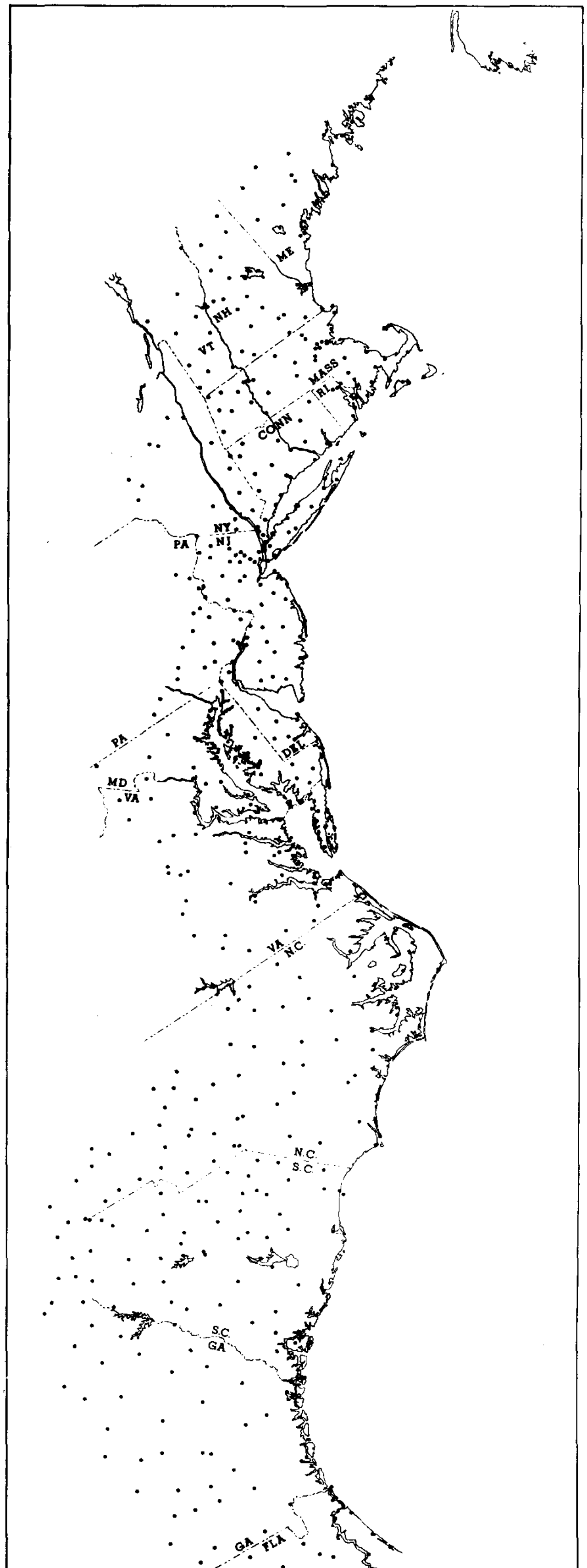

FIGURE 1.—Network of temperature stations along the Atlantic coast.

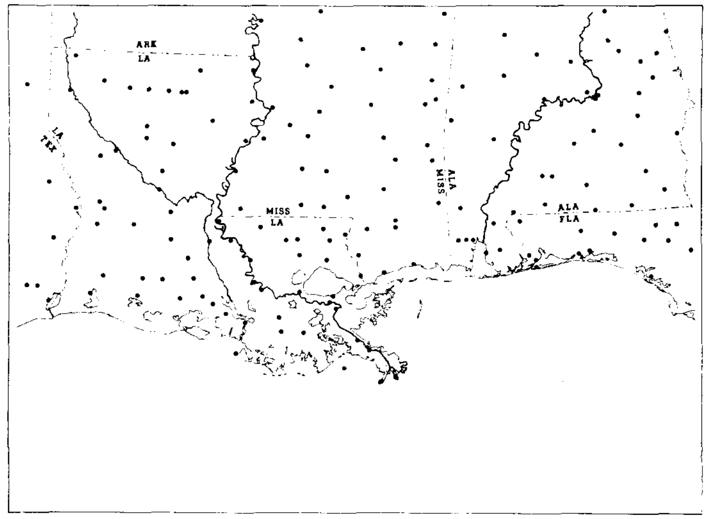

FIGURE 2.—Network of temperature stations along the Gulf coast.

found in a "belt" or "tongue" located about 25 to 75 miles inland from the coast. This "tongue" of relatively high temperature values, which is narrow and clearly defined in winter with pronounced horizontal temperature gradients, and quite broad in summer with weak horizontal temperature gradients, may be traced all along the Atlantic coast, as seen in figures 3–6. Only where the topography is complex, as in the New England area, does this "tongue" begin to lose its identity. Figure 7 indicates the main topographic features of the Atlantic seaboard.

It is reasonable to expect the daily maximum temperature to be higher over land than over water, and to decrease with increasing latitude and elevation. Figures 3–7 show that even the slight topographic slope (500 feet in about 250 miles) found in the middle and southern Atlantic States is sufficient to cause the daily maximum isotherms to be oriented from southwest to northeast, rather than from west to east. The fact that the highest temperature is found 25 to 75 miles inland, rather than along the coast, may be due to the transport of cooler ocean air inland by the afternoon sea breeze. If this is so, it is possible that the distance inland that the highest maximum temperature is found is an index of the average strength of the sea breeze in that area.

Along the Gulf coast the temperature analysis was less complicated, since the land is almost uniformly flat, the coastline is oriented west-to-east, and there are no strong water-temperature gradients offshore comparable to the Gulf Stream off the Atlantic coast. Consequently one would expect the isotherms to be oriented west-to-east with lower temperatures to the north, and any deviation from this must be due to topography or land-water contrast. The study showed that daily mean and mimimum

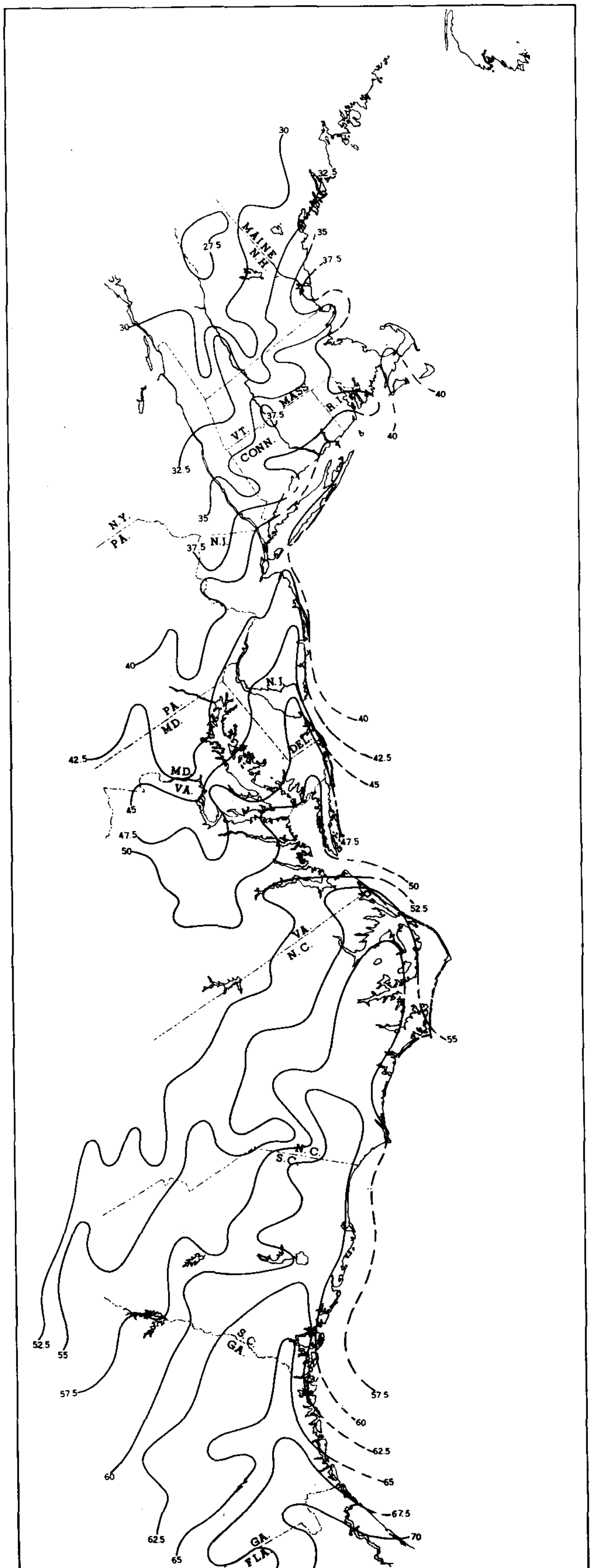

FIGURE 3.—Average daily maximum temperature (°F.) along the Atlantic coast in January.

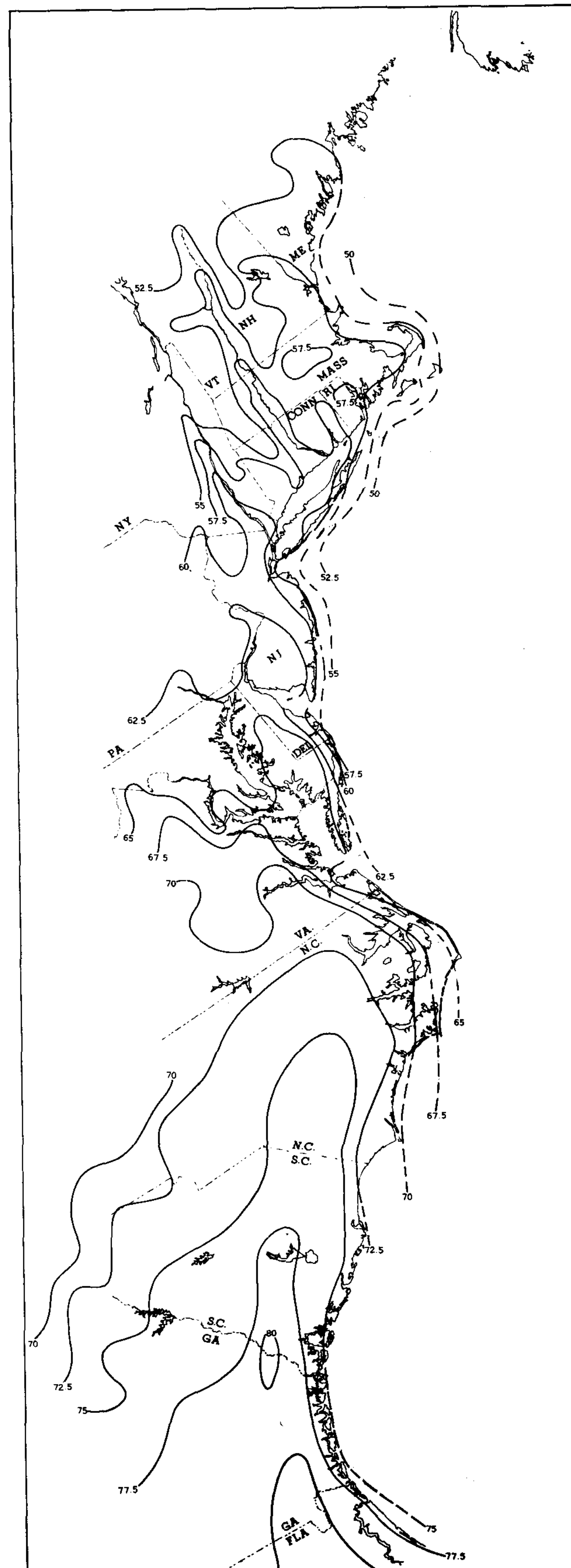

FIGURE 4.—Average daily maximum temperature (°F.) along the Atlantic coast in April.

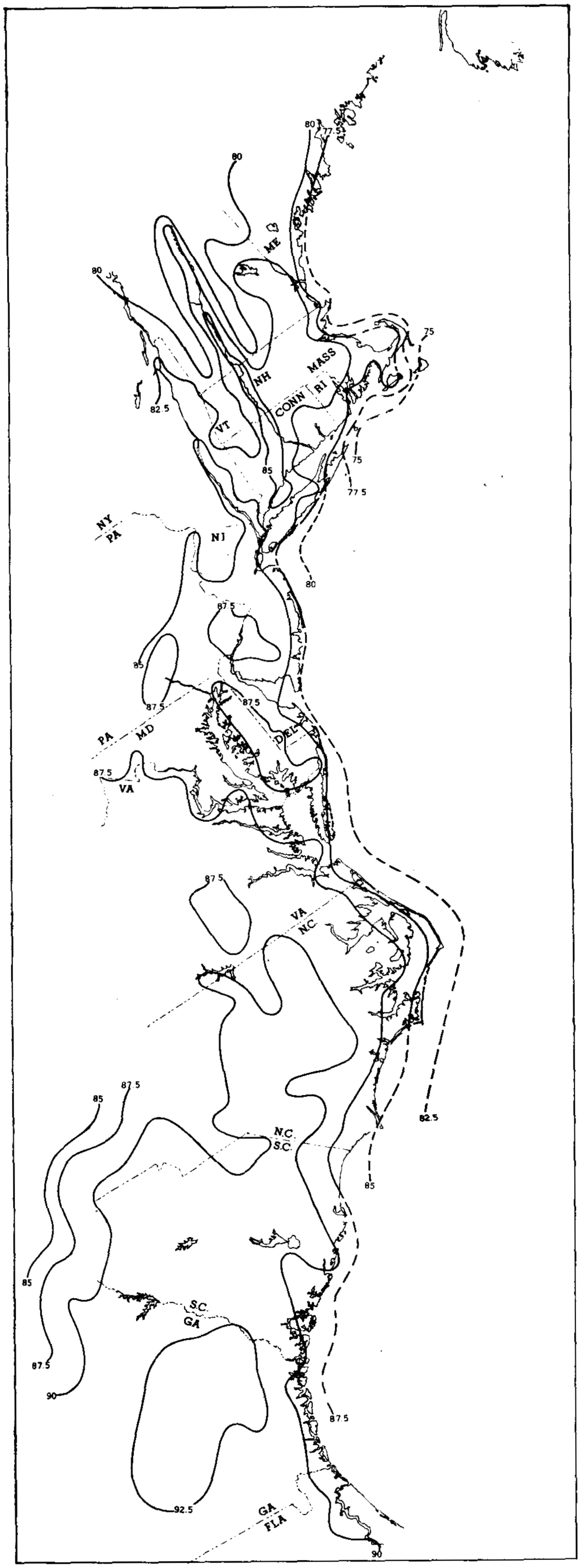

FIGURE 5.—Average daily maximum temperature (°F.) along the Atlantic coast in July.

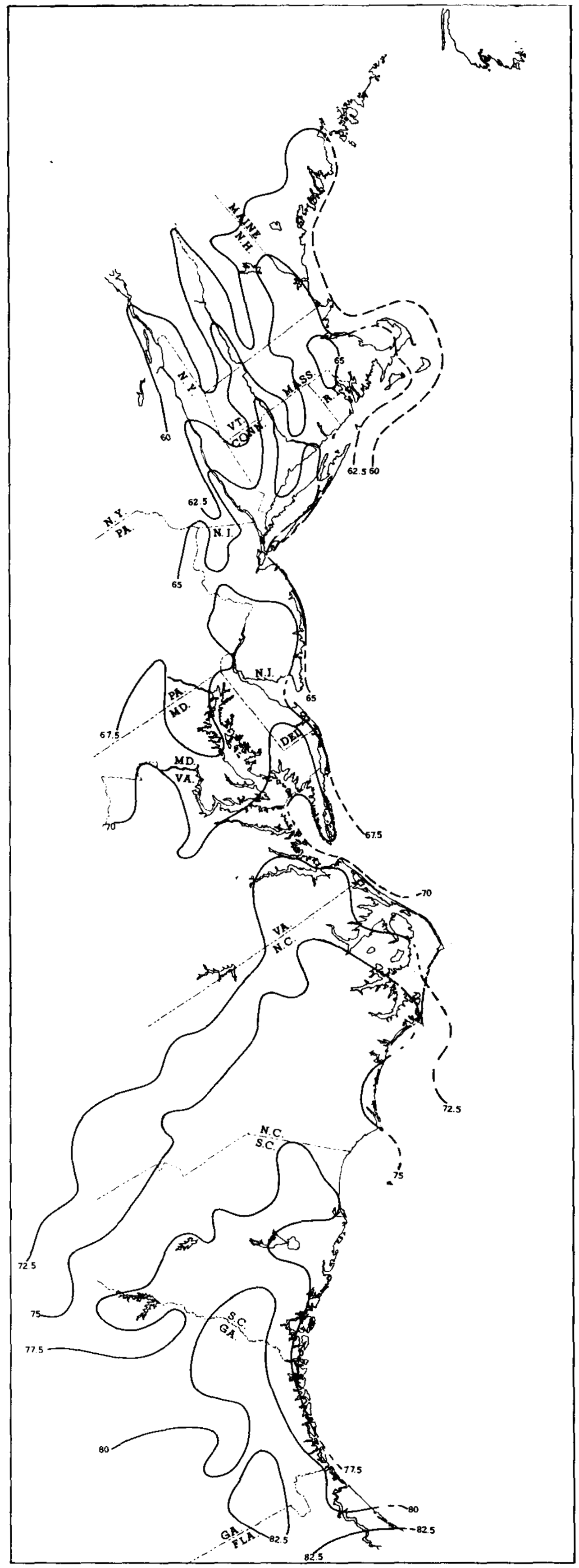

FIGURE 6.—Average daily maximum temperature (°F.) along the Atlantic coast in October.

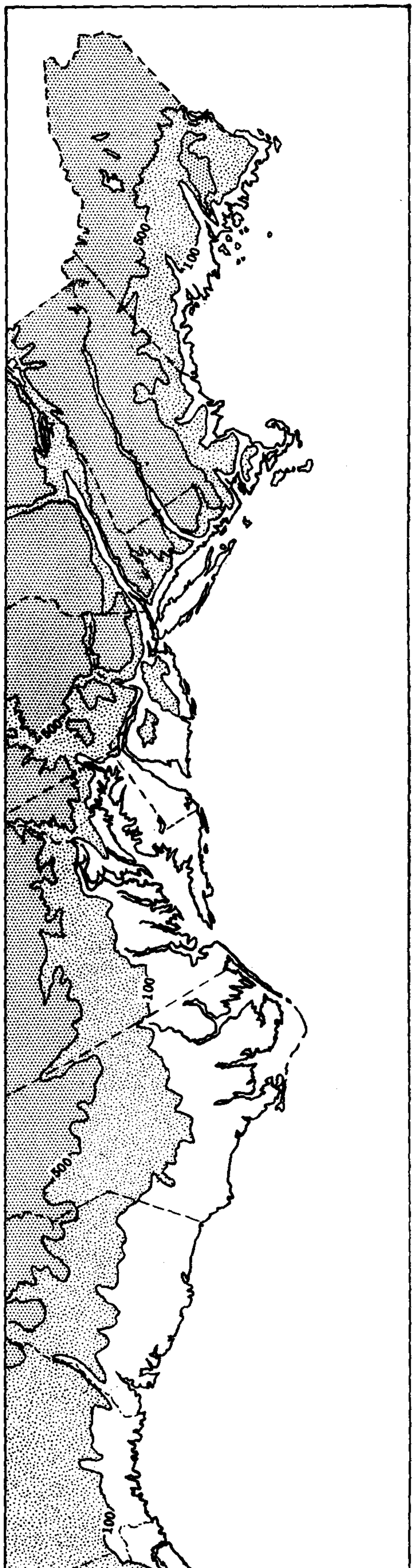

Figure 7.—Topography of the Atlantic seaboard, showing 100-ft. and 500-ft. contours.

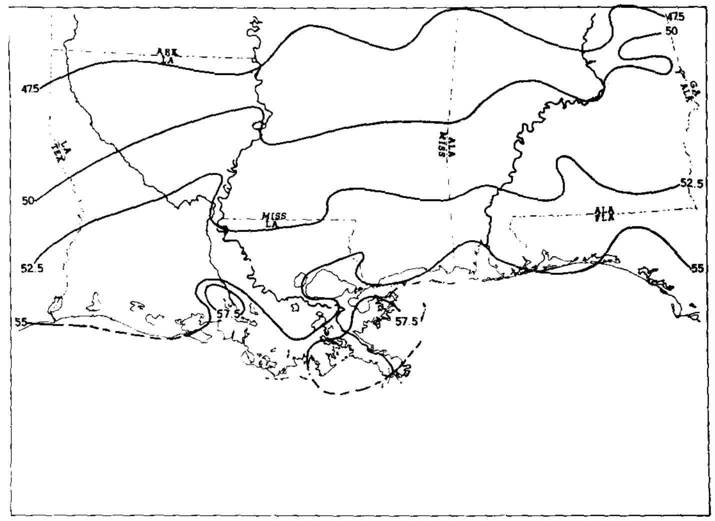

Figure 8.—Average daily mean temperature (°F.) along the Gulf coast in January.

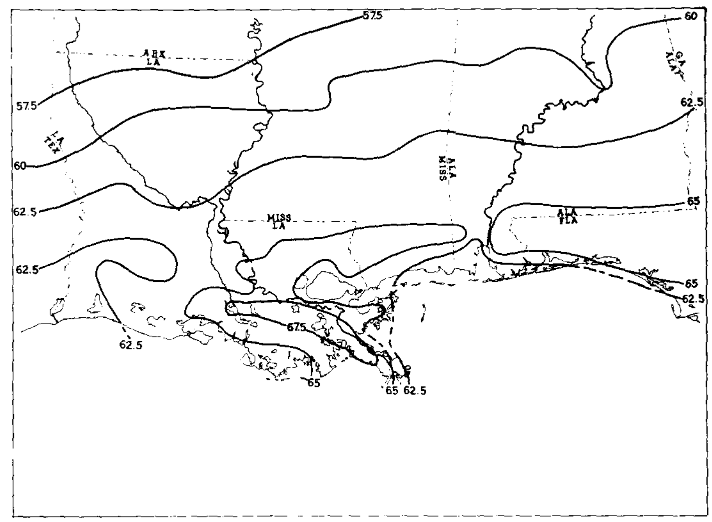

Figure 9.—Average daily maximum temperature (°F.) along the Gulf coast in January.

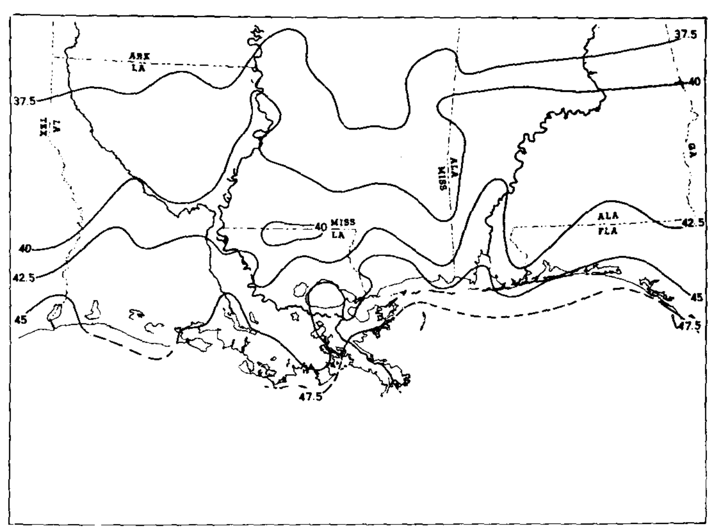

Figure 10.—Average daily minimum temperature (°F.) along the Gulf coast in January.

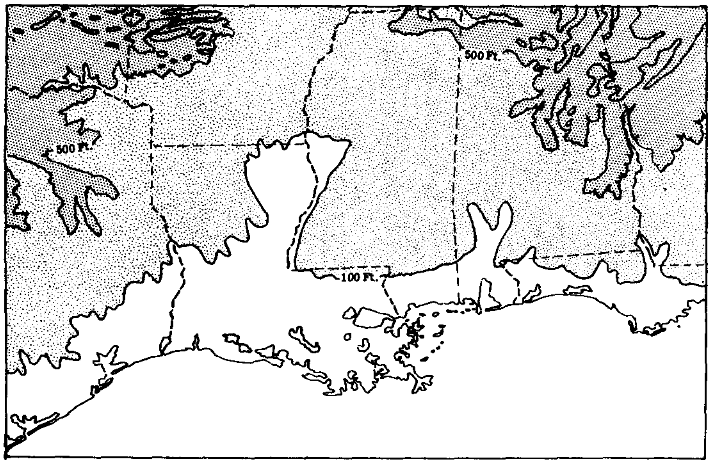

FIGURE 11.—Topography of the Gulf coast, showing 100-ft. and 500-ft. contours.

temperatures are higher along the coast than they are farther inland throughout the year, although during the summer the horizontal temperature variation is quite small. The daily maximum temperature, as along the Atlantic coast, is highest in a belt roughly 25 to 75 miles inland.

Figures 8–10 show the daily mean, maximum, and minimum temperature patterns along the Gulf coast in January. The land-water effect is quite evident in the vicinity of Lake Ponchartrain where the "inland tongue" of high maximum temperature is interrupted. The break in this "tongue" near Mobile is probably due to topography, as shown in figure 11.

3. CONCLUDING REMARKS

Despite several sources of difficulty with the data used in this study, the evidence of the "inland tongue" of high maximum temperatures is too strong to be ignored. Further, the data suggest that along the Atlantic coast the air temperature over bays and sounds rises as high during the afternoon as it does over land, while at night it does not fall as low. If this is so, it is probably due to mixing induced by stronger winds during the day, and the lack of mixing under stable conditions with light winds at night. However, this feature does not appear along the Gulf coast.

In the past there has been little climatological analysis of the local features of coastal regions, although the network of cooperative stations offers a long record of measurements of temperature and precipitation. It seems likely that a more extensive analysis of existing climatological data, especially in regions of lakes and mountains, may shed much light on the relation between local geography and climate.